The engagement in the non-agricultural sector as a risk-mitigating strategy in rural Pakistan

Tania Rajadel

Cahiers de la MSE

The engagement in the non-agricultural sector as a risk-mitigating strategy in rural Pakistan

Tania RAJADEL, TEAM

2005.04

Maison des Sciences Économiques, 106-112 boulevard de L'Hôpital, 75647 Paris Cedex 13
http://mse.univ-paris1.fr/Publicat.htm

ISSN : 1624-0340

The Engagement in the Non-Agricultural Sector as a Risk-Mitigating Strategy in Rural Pakistan

Tania RAJADEL[1]

Université Paris 1, TEAM

December 2004

[1] Université Paris 1 – Panthéon Sorbonne and TEAM.

Maison des Sciences Economiques, 106-112 Boulevard de l'Hôpital, 75647 Paris Cedex 13, France

Email: tania.rajadel@univ-paris1.fr

Résumé

Nous cherchons à déterminer si, comme le suggère souvent la littérature, la participation au secteur non-agricole constitue une stratégie de gestion du risque pour les ménages ruraux pakistanais. Cette question a déjà été abordée, mais généralement en référence à des mécanismes *ex post*, tels que le lissage de la consommation ou du revenu suite à un choc négatif. Le présent travail teste si la décision de s'engager *ex ante* dans le secteur non-agricole est partiellement influencée par des motifs de mitigation du risque. Nous utilisons à cette fin une mesure de vulnérabilité alimentaire. Celle-ci est définie comme la probabilité *ex ante* de tomber sous un seuil de pauvreté dans le futur.
Après avoir construit une variable de vulnérabilité pour chaque ménage, nous estimons, pour chaque type d'activité non-agricole (à savoir travail non qualifié, qualifié et indépendant) et à l'aide d'un probit, l'impact de la vulnérabilité sur la participation au secteur non-agricole. Nous prenons en compte l'endogénéité de la variable de vulnérabilité.
Nous trouvons, à l'encontre des hypothèses généralement formulées dans la littérature, que les ménages vulnérables ne sont pas plus enclins que les autres à s'engager dans le secteur non-agricole et ce, en raison de l'organisation inefficiente du marché du travail non qualifié ainsi que des barrières à l'entrée du secteur.

Mots-clés : risque, assurance, vulnérabilité, emploi non-agricole, Pakistan

Abstract

The paper investigates whether, as is often suggested by the literature, diversification towards the non-agricultural sector is considered as a risk-mitigating strategy by rural Pakistani households. This issue has already been addressed but usually as an *ex post* mechanism, i.e. smoothing consumption or income once a shock has occurred. The present work tests whether *ex ante* engagement in the non-agricultural sector is partly motivated by a desire to mitigate risk. The main feature of the paper is the use of an *ex ante* food vulnerability estimate. Vulnerability is defined as the probability of falling below a given threshold in the future.
After constructing a vulnerability variable for each household, we run three separate probit estimations, one for each type of non-agricultural activity (unqualified wage labour, qualified wage labour, and self-employment), in order to evaluate the impact of vulnerability on participation to the non-agricultural sector. We take into account the endogeneity of the vulnerability estimate.
We find that, conversely to what is usually assumed in the literature, vulnerable households are not more likely than others to engage in the non-agricultural sector mainly because of the inefficient organisation of wage labour markets and entry barriers.

Keywords: risk, insurance, vulnerability, non-farm employment, Pakistan

JEL classification*:* D91, O16, Q12

I. INTRODUCTION

The non-agricultural (NA) sector includes activities undertaken in rural areas of developing countries outside farming[2] such as petty crafts, shop-keeping, or even sub-contracting for large manufacturing companies. Of course, NA revenues may partly covary with agricultural income (food conditioning businesses for instance). However, their main interest comes from the fact that they are relatively independent from farming.

Hymer and Resnick (1969) suggested that NA activities would disappear as agriculture developed. Since then, studies by Hazell and Haggblade (1990) in particular showed that the NA and agricultural sector were closely interlinked and that one might stimulate the other, although direction remains unclear. This partly stems from the fact that the NA sector is extremely heterogeneous (manufacturing companies in Brazil versus basket weaving in India for example). As a direct consequence, the relationship between poverty and NA participation is not straightforward.[3]

Despite these uncertainties, taking part in the NA sector is often regarded as a shock-coping strategy. For instance, Kochar (1999) showed that negative crop shocks increased NA male wage labour in India. Biggsten and Kayizzi-Mugerwa (1995) established that the agricultural economic decline started in the seventies in Uganda induced a shift of activities towards NA ones in rural areas. These studies though, focus on *ex post* strategies and suggest that NA activities are mainly undertaken in place of agricultural ones once these have become less profitable. Entry costs may limit access to the NA sector, but these may be worth overcoming should a negative agricultural shock occur (through reallocation of time and investments for instance). NA activities may therefore merely act as substitutes for farming in times of hardship.

The question addressed in this paper is slightly different. We test whether participation to the NA sector is a risk-mitigating strategy. In other words, do households engaged in farming willingly diversify *ex ante* into the NA sector in order to reduce risk? To do so, we focus on vulnerable households, i.e. households likely to fall below a given poverty line in the future, and ask whether engagement in the NA sector is actually an option for them. Although poverty and vulnerability are strongly correlated, studying vulnerable households' activity choices enlarges the scope of analysis to relatively non-poor families[4] and enables us to investigate whether diversification into the NA sector may be considered as an informal insurance strategy as is suggested by Morduch (1995) and Ellis (1998) amongst others.

This paper uses an *ex ante* food vulnerability indicator. We estimate the future mean and variance of food consumption based on actual household characteristics using a three-step feasible generalised least square procedure. This allows for factors to influence mean and variance in opposite directions. We may therefore account for the fact that cattle and assets for instance increase expected future consumption while decreasing its variance. We then use a probit to estimate the impact of vulnerability on the engagement in the NA sector.

The paper is organised as follows. The next section presents the data and stylised facts on the non-agricultural sector. The third section reviews the literature on usual determinants of the engagement in the non-agricultural sector. The fourth section details the procedure

[2] Some authors focus on off-farm activities, i.e. activities undertaken outside the family farm, which may include agricultural labour for instance. Here, we are interested in non-farm activities, i.e. activities not directly related to agriculture. To avoid any confusion, we use the expression "non-agricultural".

[3] De Janvry and Sadoulet (2001) and Adams (1997) find that engagement in the NA sector may reduce poverty, whereas van de Walle (2000) and Reardon and al. (1992) argue that entry barriers prevent the poorest from undertaking such activities.

[4] And conversely, it excludes currently poor households unlikely to be poor in the future.

implemented to construct the vulnerability measure. The impact of vulnerability on activity choices is estimated in section five. Section six concludes.

II. STYLISED FACTS ON THE NON-AGRICULTURAL SECTOR IN PAKISTAN

It is now well established that the NA sector often has an important role to play in rural areas of developing countries. It represents on average 42% of total households' income in rural Africa, 40% in Latin America and 32% in Asia (Reardon, 1999). But the engagement in NA activities and, most importantly, the predominant types of activities, varies from one country to the next. Manufacture (61% of total NA activities in Mali) and services (39% in Cameroon, 40% in Rwanda) often come first, although gender differences may be strong: 74% of female and only 32% of male NA activities consist in services in the Brazilian Northeast for instance.

NA activities are usually either wage labour ones or self-employed ones. Barret and Reardon (2000) estimate the ratio of wage-earning to independent employment to be of 2.6 in Botswana and 2 in Zimbabwe against 0.25 in Ethiopia and 0.9 in Sudan. A further distinction needs to be made between high and low value-added activities: salaried NA activities might be unqualified (repairing roads) or qualified (civil servant) and self-employment may range from weaving baskets to setting up a small business.

This paper uses the IFPRI[5] database collected in fourteen rounds[6] in Pakistan between July 1986 and November 1991 in three provinces of the country: the Punjab, the Sind and the North-West frontier. It includes data on income, expenditures, and assets at the household level and activities at the individual level. A more extensive presentation of the survey is undertaken in Alderman and Garcia (1996).
As its initial aim was to study rural poverty, the poorest areas of the country were selected. In each of the three provinces, the less developed district was selected using an index based on production and infrastructures: Attock (Punjab), Badin (Sind), Dir (North-West frontier). As rural poverty also exists in relatively rich areas a fourth district, Faisalabad (Punjab), was added to the survey. Villages and households were then selected randomly. The sample is therefore not representative but constitutes an interesting sample for studying vulnerability. This study is based on 726 households and 3300 individuals aged 15 years old or more.

Income revenues in the IFPRI Pakistan survey are detailed in table 1: NA income amounts to 42% of total income and is the primary source of income for households whereas crop sales only contribute to 22% of total income. Disaggregating by income quintiles shows that the poorest households seem to depend strongly on the NA sector. Conversely more well-off households seem to successfully diversify their activities.

Farming represents nearly a quarter of total income on average although it is much lower for the poorest households. This may come from land constraints but also from less profitable crop choices. Land distribution is indeed unequal in Pakistan as land reforms have still not been undertaken: Adams and He (1995), on the same database, find a Gini coefficient calculated for land owned of 0.78 in Pakistan. The same authors also show that sugarcane represents 37% of crop sales for the richest households. At the time of the survey sugarcane was a highly subsidized crop. However there are high entry barriers to cultivating sugarcane (investing in new crops and fertilisers, hiring labour for the harvest for instance) and once a plot is planted with sugarcane, it can not be used for other purposes. Households can therefore not harvest twice in the same year. The poorest households, land-constrained and highly dependent on subsistence crops, can often not afford to do so. They devote an

[5] International Food Policy Research Institute
[6] The first twelve rounds were used to gather information on the first three years whereas the rounds 13 and 14 conducted in 1990 and 1991 were used to construct yearly information for the last two years.

important share of their land to rice, maize and fodder, thereby diminishing the profitability of their farming activity.

Tab. 1: Household income sources by quintile (1990)

Quintiles	*Crop Sales*	*Livestock Sales*	*Agricultural Wage Income*	*NA income*	*Rental income*	*Transfers*	*Total*
1st	15.8%	13.2%	0.7%	53.4%	3.1%	14.2%	100%
2nd	26.7%	17.2%	0.3%	42.1%	3.4%	9.6%	100%
3rd	23.9%	9%	0.2%	42.8%	4.9%	18.1%	100%
4th	22.9%	9.9%	0.1%	42%	6.5%	17%	100%
5th	23.3%	7%	0%	31.2%	14.3%	20.1%	100%
Total	22.5%	11.3%	0.3%	42.3%	6.5%	15.8%	100%

Source: IFPRI survey, year 1990
Quintiles are determined using five-year income means per capita. The first quintile is the poorest.

Livestock sales are more important for the lowest quintiles. The difference observed between the first and the second quintile probably stems from the fact that the first rear small livestock whereas the second may have enough money to buy a cow or a buffalo (Adam and He, 1995). Transfers come from different sources: the richest probably receive more remittances from migrants than the poor, more dependent on community and family support. Agricultural wage income is surprisingly small. It may be that it is undertaken by non-sedentary workers who would therefore not have been selected in the survey (Fafchamps and Quisumbing, 1998).

The database includes information on the types of NA activities individuals have undertaken: unqualified wage labour, qualified wage labour and self-employment. 70% of the households are engaged in the NA sector.

Tab 2: Households with at least one member engaged in a NA activity by quintile

Quintiles	*Unqualified wage labour*	*Qualified wage labour*	*Self-employment*	*NA activity*
1st	37.5%	18.8%	28.5%	70.8%
2nd	42%	24.5%	20.3%	70.6%
3rd	43%	29.9%	26.4%	75%
4th	21.7%	32.2%	25.9%	62.9%
5th	12.6%	37.8%	30.8%	67.8%
Total	31.4%	28.6%	26.4%	69.5%

Source : IFPRI survey, year 1990
Quintiles are determined using five-year income means per capita. The first quintile is the poorest.
The sum of the shares of NA unqualified, qualified wage labour and self-employment is usually greater than the share of the last column: some households have members engaged in different NA activities.

37% of the households of the poorest quintile have at least one member engaged in NA unqualified wage labour. The share is slightly greater for the second and third quintiles, maybe because the poorest live in remote areas and have no access to NA activities. NA unqualified wage activities includes road construction and digging irrigation ditches.

Qualified wage labour increases with the quintiles, which is logical since education is highly correlated with income. It corresponds to employment in the public and private sector. Although skills required to work in the private sector may not be that different to those required for unqualified work, it seemed best to include private employment in the qualified activities because it is more likely to be formal (working contract, full-time job…) The Daewoo Hercules Fertilizer Company was, at the time of the survey, the first private employer of the sample. 20% of the households have at least one member working in the public sector against 10% in the private sector.

More than a quarter of the households are self-employed. The data does not enable us to distinguish between high and low value-added activities. This sector includes small businesses (shop-keeping for instance) and local crafts (such as making bricks or repairing shoes).

III. TRADITIONAL DETERMINANTS OF THE ENGAGEMENT IN THE NON-AGRICULTURAL SECTOR

The engagement in the NA sector has been studied extensively in the past few years and its determinants are relatively well known by now. However as it was pointed out previously, the NA sector is extremely heterogeneous and its structure may vary considerably from one region to another. Definitions of NA activities are therefore often specific to each paper. Hence, although we know what factors are to be included in the estimations, we cannot always predict in which way they will influence activity choices. The determinants can be divided into three categories: local characteristics, household characteristics, and individual characteristics.

1. Local characteristics

Opportunities to diversify into the NA sector depend on the level of development of the region, the size and dynamism of the local market and the proximity of an urban centre. The link between the agricultural and the NA sectors is ambiguous. On the one hand, a growing agricultural sector may stimulate the development of NA activities by two channels: production (manufacturing of tools, repairing machines or conditioning agricultural products, milling) and consumption (by stimulating demand for NA products and services). Hagglabade, Hazell and Brown (1989) estimated, in a study on fifteen African countries and several Asian countries, that a $1 increase in agricultural added value could generate 50 cents increase in NA revenues in Africa. These multiplying effects were to be 1.7 times greater for Asia. On the other hand, an increase in agricultural productivity may hinder NA employment, especially if wages are low, by shifting labour to farming. Escobal (2001) introduces land productivity in his regressions on Peru. We will use regional dummies to try to capture inter-linkage effects.

The proximity of an urban centre may enhance the NA sector, first as an outlet for its products, second by subcontracting some activities in rural areas as in the Brazilian North-East (Ferreira and Lanjouw, 2001). In addition to regional dummies, de Janvry and Sadoulet (2001) use the number of urban and rural centres within an hour's reach in their estimations for Mexico. Although these variables are not significant, when interacted with gender, they show that proximity of urban centres increases female NA labour. Escobal (2001) finds that the distance to the closest town and its number of inhabitants respectively have a negative and positive impact on NA wage employment in Peru.
But the term "proximity" refers to different realities: access to urban market depends on the distance but also on infrastructure quality. Corral and Reardon (2001) use the type of roads (paths, paved roads) in their work on Nicaragua. Access to paved roads increases the likelihood of undertaking a NA wage job, but has no impact on self-employment. This last sector must be aiming for the local market only.

2. Household characteristics

Local factors influence the type of opportunities and incentives faced by households, but in the end, their characteristics determine their desire and capacity to diversify. Households less endowed with human, physical and social capital are mostly able to diversify towards low value-added activities because of low entry barriers, whereas the higher value-added sector is open to less constrained households.

The first factor to take into consideration is the quantity of land owned by the household. It is yet difficult to predict the impact of this variable. On the one hand, belonging to a household with a large farm may hinder NA participation because of farm labour requirements.[7] On the other hand, it may encourage the engagement in the NA sector: the larger the farm, the more difficult it is to finance inputs or a productive investment, especially when credit markets are imperfect. Land ownership may also have an indirect impact: if entering the NA sector requires an initial investment, land may serve as collateral. Empirical studies confirm the ambiguity of the sign of this variable. Using the same specification, Corral and Reardon (2001) and Ruben and van den Berg (2001) find that acres owned respectively reduce and increase individual engagement in NA wage labour in Nicaragua and Honduras. Nevertheless, land owned seems to have no impact of NA self-employment (Escobal, 2001; Ruben and van den Berg, 2001; Corral and Reardon, 2001; Sadoulet and de Janvry, 2001). Here, we are faced with the heterogeneity of the NA independent sector once again: it suggests that both rich and poor households in terms of land engage into NA self-employment, although the first most probably develop high value-added activities while the second undertake less profitable ones.

In Pakistan however, is seems that the more land a household has, the less likely it is to engage in NA unqualified wage labour or self-employment, but the impact on qualified wage work is less straightforward. Activities undertaken by landless households seem to confirm this point: they are more prone than the average household to engage in the NA sector (34.5% of the landless households versus 24% for the whole sample), especially in the NA unqualified wage labour (15.5% versus 9% for the sample).

***Tab. 3*:** Households with at least one member engaged in the NA sector by land quintile

Quintiles	*Unqualified wage labour*	*Qualified wage labour*	*Self-employment*	*NA activity*
1st	65.7%	29%	33.1%	82.9%
2nd	34.7%	28.6%	30.6%	75.5%
3rd	30.2%	20.1%	20.1%	61.6%
4th	20.7%	29%	25.6%	61.2%
5th	10.1%	38.7%	18.5%	55.5%
Total	31.4%	28.6%	26.4%	69.5%

Source: IFPRI survey, year 1990

Quintiles are determined using five-year landholding means. The first quintile corresponds to households with the lowest land endowments.

The interpretation of the results obtained using a land ownership variable is delicate. It is correlated to numerous factors such as access to credit or possessing liquid assets. If proxies for these factors are omitted the land variable will capture all these effects.

Some authors have information on access to credit. Ruben and van den Berg (2001) find that it has a negative impact on NA wage labour in Honduras, which suggests that it may partly alleviate liquidity constraints. But it has no impact on self-employment. Escobal (2001) finds

[7] This of course also depends on the ratio hectares of land / household size. See table 4.

the opposite: engagement in the NA independent sector in Peru must require an initial investment.

The household structure determines diversification decisions. The size of the household, once the quantity of land is controlled for, may enhance NA sector participation (Ferreira and Lanjouw, 2001). But it may also have the opposite impact (Escobal, 2001), as large families are often those with the lowest education level. Relative endowment in land and labour may be an incentive to engage in the NA sector: in the IFPRI database, households engaged in NA unqualified wage labour and self-employment are also those that present a ratio land by household size lower than average.

Tab. 4: Ratio acres of land by household size

NA unqualified wage labour	*NA qualified wage labour*	*NA self-employment*	*Engaged in the NA sector*	*Not engaged in the NA sector*	*Whole sample*
0.66	1.56	0.72	0.97	1.35	1.26

Source: IFPRI survey, year 1990
Number of acres of land owned by household member.

The ethnic group a household belongs to may influence its diversification capacity. De Janvry and Sadoulet (2001) show that foreigners have a lower likelihood of engaging in the NA sector in Mexico. Reardon, Delgado and Matlon (1992) reach a similar conclusion regarding the Guinean region in Burkina Faso: not belonging to the dominant ethnic group reduces the share of NA income in total income.

An other variable to consider is the engagement in livestock rearing. Escobal (2001) finds that the number of sheep owned reduces NA unqualified labour and self-employment. Ruben and van den Berg (2001) obtain a similar result using cattle. The authors present this as a mechanical time constraint: the more productive agricultural assets a household owns, the less time its members have to undertake a NA activity. However, cattle and stock are also considered to be potential liquidity reserves in low developed countries with imperfect credit and savings markets (Ellis, 1998; Rosenzweig and Wolpin, 1993). Such a variable may also capture liquidity constraints.

The impact of landholdings, credit constraints, livestock and cattle owned, and household structure varies across countries and the types of NA activities studied. The literature mainly tackles the issue of the substitution of farming for NA activities in the light of either time or liquidity constraints, which are seen as an incentive (financing a productive asset for instance) or an entry barrier (initial investment required). The question of household vulnerability remains unaddressed. But liquidity constraints are also an important element of vulnerability: a household unable to obtain credit or to sell assets should a shock occur, in other words a household unable to smooth consumption, is more vulnerable to negative outcomes. This could increase its desire to diversify into NA activities. We will return to this question further on.

3. Individual characteristics

Labour markets are segmented by gender, age and education. Studying the participation to the NA sector should therefore be conducted at the individual level.
In most developing countries, gender is a crucial determinant of individual activities. Newman and Canagarajah (2000) studied the impact – differentiated by gender – of the NA sector on poverty in Ghana and Uganda. They found that the range of NA activities opened to women (petty sales of agricultural products or crafts) was much narrower than that to men (public administration, business, manufacture, construction, transport). In Ghana, women have a significantly lower likelihood of engaging in a NA wage activity than men, but higher one

when it comes to self-employment. The opposite result is obtained for Uganda. Lanjouw (1999) and Ferreira and Lanjouw (2001) find that in Ecuador and in the Brazilian North-East men are more likely than women to be a NA qualified wage earner.
In Pakistan women seem to have little access to the NA sector. This is particularly pronounced in the case of wage labour (qualified or not), which requires undertaking an activity outside from home. Although women are not massively engaged in self-employment, they do represent more than a quarter of this sector, which suggests that they can work from home without violating religious or cultural restrictions imposed on them.

Tab. 5: Non-agricultural activities and gender in Pakistan

Gender	NA unqualified wage labour	NA qualified wage labour	NA self-employment	Total NA employment
Male	93.5%	94%	71.4%	87.3%
Female	6.5%	6%	28.6%	12.7%
Total	100%	100%	100%	100%

Source: IFPRI survey, 1990
Individuals aged 15 or more

Bigsten and Kayizzi-Mugerwa (1995) stress the importance of life-cycle aspects. The youngest are often better endowed with human capital (such as health or education) but have not yet accumulated assets (land or cattle). Older people have generally already transferred their owning to their children and cannot undertake physically demanding tasks. The authors show that propensity to engage in a NA independent activity diminishes with age. Escobal (2001) obtains the same result. Conversely, Corral and Reardon (2001), Lanjouw (1999) and Ferreira and Lanjouw (2001) find that the likelihood of undertaking a NA activity, whether self-employed or not, increases with age.

Gender or age variable might however capture experience or education effects. In general, educated individuals are more prone to participate to the NA sector (Ruben and van den Berg, 2001; Escobal, 2001). Ferreira and Lanjouw (2001) show that education increases the likelihood of undertaking a NA qualified job. The impact of education on self-employment is not as straightforward: in de Janvry and Sadoulet (2001) it is positive, in particular for superior education, whereas in Corral and Reardon (2001) it is not significant. This probably stems from differences in entry barriers between the independent sectors of Mexico and Nicaragua.

In the IFPRI survey, two-thirds of the individuals aged 15 or more received no formal education (table 6). In nearly half of the households engaged in the NA sector, no member ever went to school. The shares obtained for the NA unqualified wage labour correspond to what might have been expected, but those concerning qualified wage work and self-employment are not linear. Nevertheless, when compared to mean sample statistics, they do confirm that education influences the engagement in these last two activities.

Activity choices of individuals also depend on their relation to the head of the household. In de Janvry and Sadoulet (2001) as in Corral and Reardon (2001), the heads' spouses are less likely to engage in a NA wage activity. However, their chances of undertaking an independent activity are similar. In Biggsten and Kayizzi-Mugerwa (1995) and in Corral and Reardon (2001) being the household head only has a significant impact on participation to the NA self-employed sector. These results must be considered with caution as they also capture gender and maybe age effects.

Tab 6: Non-agricultural activities and education in Pakistan

Years of study	NA unqualified wage labour	NA qualified wage labour	NA self-employment	Total NA employment	Total sample
0	62.3%	25.9%	52.8%	47.5%	66.3%
1 - 5	21.6%	15.4%	16%	17.9%	14.1%
6 - 10	15.1%	39.2%	26%	26.2%	16.4%
> 10	1%	19.5%	5.2%	8.4%	3.2%
Total	100%	100%	100%	100%	100%

Source: IFPRI survey, 1990
Individuals aged 15 or more

Household heads seem more likely to undertake a NA activity in the IFPRI survey: 41% of the heads are engaged in a NA activity against 24% for the whole sample. But the strong correlation between the relation to the head of the household and gender[8] limits the accuracy of these figures: are household heads likely to engage in the NA sector because of their role within the family or because they are males? Nevertheless, table 7 suggests that heads are more likely to undertake a NA independent activity, whereas heads' sons are less likely to do so, probably because they are expected to take over the farm.

Tab 7: Non-agricultural activities and relation to the household head in Pakistan

Relation to the head	NA unqualified wage labour	NA qualified wage labour	NA self-employment	Total NA employment
Head	14.4%	11.8%	15%	41.2%
Head's child	15.3%	13.6%	5.8%	34.7%
Head's spouse	2.5%	1.1%	4.5%	8.1%
Total	9.2%	8.1%	7%	24.3%
Male	15.9%	14%	9.1%	39%
Female	1.3%	1.1%	4.4%	6.8%

Source: IFPRI survey, year 1990
Individuals aged 15 or more

The characteristics we have just mentioned mix capacity and incentives to diversify towards the NA sector. A household's, or one of its members', capacity depends on its localisation, which conditions the existence and nature of entry barriers, and on its endowments in physical and human capital, which enable it to overcome – or not – those barriers. As for incentives, they may be less directly observable, in particular when entry barriers are high. Some may be listed though: poor banking intermediation, liquidity constraints hindering productive investments, land to household size ratio or relative profitability of the sector compared to agriculture.

One element missing in this literature is risk. Of course, it is not completely absent: as we pointed out liquidity constraints may enhance risk for instance. The role of NA activities in consumption smoothing has been studied by Kochar (1999) in particular. She shows that households react to crop shocks by increasing male participation to the NA wage market. She also finds that households will only borrow when facing a shock if they are unable to compensate the income shock by labour (for instance if there are too few men within the household). Moreover, Bigsten and Kayizzi-Mugerwa (1995) show that the economic decline

[8] 99% of the heads and 78% of the heads' children are male (daughters are probably married quite young).

started in the late seventies by Uganda profoundly changed the income typology of rural households in the district of Masaka. The crisis impoverished the links between urban and rural areas increasing household vulnerability to crop shocks. Households not only diversified crops planted towards subsistence crops but also widely engaged in NA activities for the local market (construction and services). These studies present the NA sector as an alternative to farming once a shock has occurred, ex post. But they do not say whether NA activities are regarded as complementary to agriculture or as mere substitutes to agriculture once it has become less profitable. We wish to investigate whether, for farmers, diversification into the NA sector is partly motivated by a desire to mitigate risk. In other words, are vulnerable farmers more likely to diversify ex ante into the NA sector?[9]

IV. ESTIMATING VULNERABILITY

Poverty concerns a greater range of households than those strictly identified as being poor at any given point in time. Households, in particular those close to the poverty line, may indeed exit poverty one year only to re-enter it the next. Although poverty measures have brought attention to populations with specific needs and behaviours, they only provide a blurred reflection of reality. As these measures are static, they do not incorporate risk. A household's current poverty status may therefore not be the best indicator of its likelihood of being poor in the future, i.e. of its vulnerability.

We define vulnerability as the ex ante probability of remaining poor if currently poor or becoming poor if currently non-poor. Vulnerability is thus forward-looking as opposed to poverty that can only be measured ex post. Moreover, it is not directly observable whereas poverty is. So one can only estimate vulnerability. Ligon and Schechter (2003), Kamanou and Morduch (2001), Pritchett and al. (2000), and Dercon (2001) namely propose critical surveys and alternative procedures to the one we will be using. They mainly focus on discussing how to assess vulnerability, its determinants and regional disparities. Our perspective here is slightly different: we will be using a vulnerability estimate to evaluate its impact on activity choices.

When studying choices facing uncertainty, in particular diversification into the NA sector as a risk-mitigating strategy, it appears more appropriate to use a vulnerability indicator, rather than a static measure, because of its risk component in particular but also because it is an ex ante measure.

1. Defining vulnerability

We propose to assess vulnerability in terms of food poverty using a method proposed by Christiaensen and Boisvert (2000). The focal variable used for the estimation is food consumption expenditure per capita.[10] This definitely restricts vulnerability to a single feature, although critical for the poor. Poverty is definitely multi-dimensional: it is not limited to income or consumption levels but incorporates information on access to education or health for instance. Vulnerability estimates should therefore take into account these aspects. However, we were unable to enrich our indicator here namely due to a lack of data. In particular, we

[9] We only study households engaged in farming (73% of the whole sample) and regard engagement in the NA sector as a diversification strategy, although we cannot exclude that some households may be changing activities. Moreover, descriptive statistics in section one show that NA income is the primary source of income on average for the whole sample. But, if one were to only consider households engaged in agriculture, crop sales would represent 39% of total income, livestock sales 11% and NA income 32% (figures vary according to quintiles, but crop sales always remains the first income source). Hence, it is relevant to speak about diversification into the NA sector as agriculture is the main activity.

[10] Including home-consumption.

focus on quantitative information, food consumption expenditures, without taking into consideration qualitative characteristics such as malnutrition.

Using the Foster, Greer and Thorbecke (1984) poverty measure, vulnerability of a given household at time t may be expressed as follows:

$$V_t^{\alpha} = \int_0^z (z - c_{t+1})^{\alpha} f_t(c_{t+1}) dc_{t+1}$$

where c_{t+1} is the household's future food consumption, z a given poverty line and f_t the ex ante probability density function for future consumption. For $\alpha = 0$, V_t^0 corresponds to the probability at time t that a household's future food consumption will fall below the poverty line. A household will be regarded as vulnerable if its probability of falling below the poverty line in the future exceeds a probability related threshold τ. For $\alpha = 1$, V_t^1 estimates the expected gap between future food consumption and the poverty line, i.e. the expected consumption shortfall. For the time-being, we will only work with V_t^0.

Once the two thresholds (z and τ) are fixed, assessing vulnerability requires information on the ex ante food consumption distribution. Based on the Shapiro – Wilk test for normality, we could not reject the hypothesis that per capita food consumption was lognormally distributed in our data.[11] Hence, all we need to estimate V_t^{α} are the ex ante mean ($\mu_{\ln c_{t+1}}$) and variance ($\sigma^2_{\ln c_{t+1}}$) of the household's per capita food consumption.

As suggested previously, vulnerability may be defined differently. Cunningham and Maloney (2000), for instance, focus on adverse shocks to welfare when assessing who suffered from the Mexican crisis in 1995. They hence include households likely to experience a strong negative shock but rich enough to remain above the poverty line and similarly exclude poor households with a low probability of facing a negative outcome. However, rich households at risk of being hit by an adverse shock will not develop the same income diversification strategies as poor ones in the same situation: they simply do not have the same opportunities. Moreover, a rich family is more likely than a poor one to have chosen to take part in a risky activity, and possibly fail, making negative outcomes partly endogenous. This may also occur for poor households but for different reasons (health for instance). The vulnerable population identified by Cunningham and Maloney is far too heterogeneous for our purpose. Here, we ask whether households at risk of becoming or remaining poor are more likely to engage in the NA sector.[12]

2. Estimating the ex ante mean and variance of food consumption

We use an inter-temporal model developed by Christiaensen and Boisvert (2000) to estimate the ex ante mean ($\mu_{\ln c_{t+1}}$) and variance ($\sigma^2_{\ln c_{t+1}}$) of the household's per capita food consumption (see appendix 3). They propose a simple two period model: risk averse households maximize inter-temporal expected utility and derive income from two different sources labour and gifts (as an insurance mechanism). The model shows that determinants of the ex ante mean and variance of food consumption may be split up into three categories: income (distribution characteristics), savings and credit (wealth, expected future income, volatility of future income, risk aversion, time preference), and insurance (ability to smooth consumption should a shock occur).

[11] Prob>z: 0.241

[12] We are implicitly supposing here that our "objective" or exogenous estimation of vulnerability corresponds to how households perceive their own vulnerability status, which may very well not be the case. This will require further investigation.

The stochastic consumption function may be written as:

$$\ln c_{it+1} = X_{it}\beta + e_{it+1}$$

where X_{it} contains household characteristics (income, saving and credit, and insurance) as listed above and e_{it+1} is a mean-zero disturbance term. However we assume the disturbances are not identically distributed across households (heteroscedasticity) and allow the variance of e_{it+1} to depend linearly upon X_{it}:

$$\sigma^2_{eit+1} = X_{it}\theta$$

β and θ are estimated using a three-step feasible generalised least squares (FGLS) procedure as in Chaudhuri and al. (2002)[13] and the ex ante mean and variance of future food consumption conditional on X_{it} are derived using $\bar{\beta}$ and $\bar{\theta}$:

$$\overline{\mu_{\ln cit+1}} = X_{it}\bar{\beta} \quad \text{and} \quad \overline{\sigma^2_{\ln cit+1}} = \overline{\sigma^2_{eit+1}} = X_{it}\bar{\theta}$$

Although theses assumptions are stringent, they enable us to account for the fact that household characteristics may influence consumption mean and variance in different directions: for instance land irrigation may reduce consumption variance while increasing its expected value.

The determinants of the ex ante mean and variance of food consumption may be grouped into three categories: income, savings and credit, and insurance. All regressors included in the specification were constructed using information at time t (i.e. 1989) as stipulated above, whereas food consumption is that of 1990.

The distribution characteristics of total income remain unknown. Following Christiaensen and Boisvert (2000), we use a set of human capital, productive assets and income diversification variables. We include age and gender groups as household composition strongly impacts income-generating capacities: large dependency ratios or small male/female ratios (especially in developing countries with highly gender-segmented labour markets) may hinder income-generating opportunities. We also use the number of ill adults. Although two-thirds of individuals aged fifteen or more never went to school in our sample,[14] at least one member completed primary school in more than half of the households, so we add a dichotomous variable, which is one if at least one member completed primary school.[15]

We also include total value of agricultural productive assets (tools and machines, mainly tractors single or jointly-owned by farmers). The number of cows and buffaloes are added to the specification.

Income diversification influences ex ante income variance in particular. As we noted earlier, the share of land planted with sugarcane may strongly reduce income variance as it was a highly subsidized crop at the time of the survey. We also include the shares of crop sales and NA income in total income in 1989: NA and agricultural incomes should not be completed correlated, namely because NA wage labour or self-employment are not fully tied to crop outcomes.[16] Using NA income share in the specification may seem problematic as we intend to use our vulnerability measure to determine whether it influences individual engagement in the NA sector in 1990. We will discuss this issue later on. We also know what

[13] See appendix 4 for details. Procedure is similar to that implemented by Christiaensen and Boisvert (2000).

[14] The poor education observed in the survey is mostly that of women: 60% of male individuals aged fifteen or more completed primary school whereas only 10% of females did.

[15] We do not control for the gender of the household head as very few households are female-headed in Pakistan.

[16] Wages from the public sector or revenues from independent activities having developed commercial ties with the district or the province urban areas will not depend on crop outcomes.

share of the operational land is irrigated. As it diminishes dependence on rainfall outcomes and also enables households to plant more crops throughout the year, it is expected to reduce income variance.

The second set of factors influencing ex ante food consumption mean and variance are savings and credit. As was highlighted earlier, small stock (goats, sheep) may be partly used as saving assets (Ellis, 1998; Rosenzweig and Wolpin, 1993). We also have information on borrowing. In 1989, only 2% of surveyed households borrowed from formal sources whereas 74% borrowed from informal sources (roughly 24% from relatives and 23% from shopkeepers) with no interest rate. More than half of the loans were motivated by consumption purposes and collateral was only seldom required (in 10% of the cases, but, then collateral was usually crop output, not land). It seems therefore that credit is mostly used as an insurance in our survey and we include it as such. The share of transfers from relatives in total income may be considered either as a diversification strategy (Rosenzweig and Stark, 1989) or as an insurance mechanism if remittances increase when shocks occur (Lucas and Stark, 1985; Fafchamps and Lund, 2000).[17]

Tab 8: Estimation of the conditional ex ante mean and variance of food consumption per capita (FGLS)

	$\overline{\mu_{\ln cit+1}} = X_{it}\,\bar{\beta}$		$\overline{\sigma^2_{\ln cit+1}} = X_{it}\,\bar{\theta}$	
	Coefficients	*P > |z|*	*Coefficients*	*P > |z|*
Human Capital				
Number of adult males	- 0.011	0.816	- 0.019	0.302
Number of adult females	- 0.006	0.295	- 0.0166	0.783
Number of children (<15 yrs old)	- 0.045	0.003	- 0.039	0.092
Number of elderly (>65 yrs old)	- 0.052	0.463	0.014	0.801
Age of the household head	0.005	0.824	- 0.003	0.678
Age of the household head squared	- 0.001	0.938	0.003	0.851
Education (=1 if at least one adult household member completed primary school)	0.024	0.094	0.286	0.794
Number of ill adults (≥15 yrs old)	- 0.022	0.015	0.088	0.883
Productive assets				
Values of Productive assets	1.26e-06	0.240	- 1.57e-07	0.574
Number of cows and buffaloes	0.026	0.076	- 0.042	0.039
Income diversification				
Share of crop sales in total income	0.296	0.193	- 0.021	0.618
Share of NA income in total income	0.301	0.088	- 0.069	0.351
Share of acres planted with sugarcane	0.367	0.000	- 0.331	0.018
Share of operational land irrigated	0.346	0.074	- 0.214	0.076
Savings, credit and insurance				
Number of goats and sheep	0.019	0.094	- 0.003	0.102
Amount borrowed in 1989 from informal sources	- 5.28e-06	0.172	1.58e-06	0.781
Transfers	0.181	0.364	0.210	0.198
Nb obs: 419 households				
Regional dummies were included	R^2: 57.12	F: 23.78	R^2: 28.09	F: 13.21

Source: IFPRI survey. All independent variables constructed for 1989. Dependent variable (food consumption) constructed for 1990.

Table 8 presents the determinants of conditional ex ante mean and variance of food consumption per capita. The signs of the coefficients found for the numbers of cows buffaloes and for the share of sugarcane justify the econometric procedure we undertook:

[17] Insurance is implicitly defined as consumption smoothing (as gifts are expected to increase when negative outcomes occur). Should it be defined in a broader way as to include income smoothing strategies as well, variables such as income diversification could be interpreted as such.

these variables have a positive impact on ex ante mean food consumption but a negative impact on variance.

The number of children has a negative impact on expected mean food consumption, as expected, but also on variance. Households with children are probably better able to smooth consumption, maybe because they undertake less risky activities. Primary education seems not to influence future consumption variance but does have a positive impact on expected consumption. The number of ill adults decreases expected food consumption without affecting its variance.

The coefficient for productive assets is not significant. This may be due to measurement errors in evaluating the value of farming tools. Owning cows or buffaloes tends to increase ex ante mean food consumption and to decrease variance. This suggests that they may help smooth consumption in times of hardship: households may either sell them or rent them out as draft animals.

The share of crop sales has no impact on future food consumption distribution. This may come from the fact that it is mechanically correlated to the NA share as they are the first two income sources or that food consumption is relatively well insulated from crop outcomes. The income share of NA activities seems to have an impact on mean food consumption, but not on its variance, which may suggest that it is not a risk-mitigating strategy. This issue will be addressed again in the next section. Results regarding sugarcane are consistent with the fact that it is a highly subsidized crop. The share of irrigated land increases expected food consumption and reduces its variance.

Goats and sheep seem to play a similar, although weaker, role as cows and buffaloes. Our data suggests that livestock serves as a buffer stock, which is consistent with Rosenzweig and Wolpin (1993), although other studies (Fafchamps, Udry and Czukas, 1998) find no evidence of such insurance mechanisms.

Transfers or amounts borrowed seem to have no effect on future food consumption distribution. This is surprising, especially for borrowing as shopkeepers issue 23% of the loans. The data may not be of good enough quality or borrowing may be correlated with other variables.[18] Moreover, these last two variables only include flows in cash (information on in-kind gifts was not collected) and they may hence be used for other purposes than food consumption, i.e. ceremonial expenses or clothes.[19]

3. Constructing the vulnerability measure

As we assume food consumption per capita is lognormal, once its ex ante mean and variance are determined, we only need to fix a poverty line and a probability-related threshold to estimate a household's vulnerability status and its expected consumption shortfall.

We employ a relative food consumption poverty line as recommended by Alderman and Garcia (1996) on the same database: the poverty line is set at the second bottom quintile of our sample, which roughly corresponds to Rs 750 (40% of our sample).[20] Some authors arbitrarily set a probability threshold at 50%. We prefer using an other threshold proposed by Chaudhuri and al. (2002): households are classified as vulnerable if their probability of experiencing poverty in the future is higher than the poverty incidence (40% here).

[18] Although collateral is seldom required it might still influence behaviours: people may be more willing to lend to a household owning livestock or some kind of asset than to a household with none.
[19] See Duflo and Udry (2003) on mental accounts.
[20] Recall that our sample is not representative, as it selected the poorest areas of Pakistan, hence a poverty incidence of 40% is reasonable.

According to our estimations, 51% of the households were classified as vulnerable in 1989, i.e. were at risk of falling below the poverty line the next year (1990). Table 9 compares the prediction of the vulnerability indicator and actual outcomes. Approximately 80% of all households were correctly classified. Moreover, 72% of the households who fell below the food poverty line in 1990 were found to be vulnerable in 1989. The vulnerability measure therefore seems to have an accurate predictive power.

Tab 9: Food vulnerability and actual poverty in 1990

		Actual food consumption level in 1990		
		Above the poverty line	*Below the poverty line*	*Total*
Vulnerability as estimated in 1989	*Non vulnerable*	164 *(43%)*	19 *(6%)*	183 *(49%)*
	Vulnerable	54 *(14%)*	137 *(37%)*	191 *(51%)*
	Total	218 *(58%)*	156 *(42%)*	374 *(100%)*

Source: IFPRI survey
The share of households below the poverty line is higher than 40% because of missing values when estimating vulnerability.

A better understanding of the sources of vulnerability may stem from dividing the households into three groups (see Chaudhuri and al. 2002). The first group includes households with an estimated vulnerability below the probability threshold of 40%. They are the non-vulnerable. The second group includes households classified as vulnerable but with expected food consumption above the poverty line. They are considered to be vulnerable mostly because of the high variability of their consumption. Finally, the third group is composed of vulnerable households with expected food consumption below the poverty line. Their vulnerability should mostly come from their low level of mean consumption.[21] We find that 20% of the households classified as vulnerable appear to be so due to high consumption volatility. Hence, although most households are vulnerable because they are poor, about 10% of the whole sample seems to be vulnerable because it is at risk of experiencing relatively important fluctuations of food consumption.

V. THE IMPACT OF VULNERABILITY ON THE ENGAGEMENT IN THE NON-AGRICULTURAL SECTOR

The vulnerability estimates constructed in the previous section will help investigate whether the engagement in the NA sector is motivated by risk-mitigating concerns.

Table 10 shows that only 43% of individuals engaged in the NA sector belong to vulnerable households. These figures suggest that members of vulnerable households may be less likely than others to undertake NA activities. Disaggregated data lead to the same conclusion: vulnerability seems to hinder participation to the NA independent sector and, even if to a lesser extent, to NA qualified labour. As for the NA unqualified labour market, impact of vulnerability appears to be unclear: other factors might be more determinant. A more rigorous approach should enable us to confirm this impression.

[21] Expected future food consumption for the second group (high volatility group) amounts on average to about the double of the third group (low mean group) whereas variance is more than fifty percent higher in the second compared to the third group. However, although this is true on average, some vulnerable households with expected future consumption below the poverty line also display high ex ante variability of consumption. This is only a rough classification, results should be interpreted with caution.

Tab 10: Household vulnerability and individual NA employment

Vulnerable	NA unqualified wage labour	NA qualified wage labour	NA self-employment	Total NA employment
Yes	55%	40%	37%	43%
No	45%	60%	63%	57%
Total	*100%*	*100%*	*100%*	*100%*

Source: IFPRI survey

As factors determining the engagement in the NA sector depend on the type of activity (section two), it seemed best to run estimations separately for each one (unqualified wage labour, wage labour and self-employment). Using a Smith and Blundell (1986) test for exogeneity, we could not reject the hypothesis that the vulnerability variable is endogenous. We use the number of ill adults as an instrument as it should only impact activity choices through increased vulnerability. We only kept households engaged in farming as our focus is on diversification motives. Finally, as the focus is on ex ante decisions, all variables were constructed for 1989 whereas activity choices are those assessed in 1990.

The variables used in the estimation include traditional determinants presented in section two, i.e. local characteristics, household characteristics and human capital characteristics. We add the dichotomous vulnerability variable. Results are presented in table 11.

Specific local characteristics do not seem to have a real influence on NA sector engagement, except for public transports that facilitate access to employment opportunities, but most of their effects are probably captured in the district dummies included in the regression and highly significant. Note that public transports have a negative impact on undertaking a NA independent activity: incentives to open a small shop for instance might be greater if the village only has a limited access to others markets.

Tab 11: Determinants of the participation to the NA sector using probits (Smith and Blundell instrumental procedure)

Variables	NA unqualified wage labour		NA qualified wage labour		NA self-employment	
	Coefficients	*P > |z|*	*Coefficients*	*P > |z|*	*Coefficients*	*P > |z|*
Number of adult males	.207	0.008	.143	0.001	.111	0.032
Number of adult females	.083	0.310	-.036	0.175	.094	0.086
Number of children	.011	0.730	-.043	0.657	.021	0.514
Number of elderly	-.026	0.942	-.986	0.328	.554	0.575
Age of head	.027	0.007	.381	0.082	.259	0.043
Age of head squared	-.002	0.042	-.004	0.102	-.003	0.297
Education	-.244	0.836	.978	0.000	.814	0.041
Vulnerability	-2.06	0.855	-2.194	0.061	-4.32	0.047
Land	-.0.21	0.024	-.033	0.216	-.027	0.021
Distance to local market	-.021	0.134	.059	0.354	.029	0.638
Paved road to tehsil capital?	-.381	0.498	-.548	0.352	.761	0.188
Public transport in the village?	.231	0.106	.192	0.509	-.066	0.101
Log likelihood	-1160.36		-1164.85		-1156.95	
Pseudo R2	0.27		0.29		0.23	

Source: IFPRI survey. Independent variables constructed for 1989. NA activity choices are those of 1990.
Comparison group: Engaging in no NA activity Number of observations: 358
Clustered by household, district dummies included in the regression
Instrument: number of ill members

The number of adult males has a positive impact on the engagement in the NA sector whereas the number of adult females is only significant (with a small coefficient however) for self-employment: women are discouraged from undertaking income-generating activities outside the family home. Households with relatively older heads are more likely to participate to the NA sector although the coefficient is small for unqualified labour: it seems that entering the NA sector requires some form of initial capital (human, financial, social…) that only the most experienced own. The impact of education is significant and positive for NA qualified wage labour as expected, but also for self-employment, thus suggesting that it might be on a average fairly high value-added. Land has a negative influence on the likelihood of engaging in NA wage labour and self-employment implying that households may only devote labour to such activities once the farm is taken care of.

Vulnerability has no significant impact on the likelihood of participating to the unqualified wage labour market relative to undertaking no NA activities. As there are no real entry barriers to that sector – except gender-related ones – the reasons why vulnerable households do not engage more than others in such activities must stem from other factors. As pointed out above, landholdings have a negative impact, thus suggesting that unqualified wage labour only attracts individuals belonging to relatively small farms and when marginal returns to their labour on the farm is less than outside it. We also ran estimations including the ratio of land per household member and found this variable to be significant and negative. Participating to the NA wage labour market does not appear to be a risk-mitigating strategy: farmers seem to allocate labour to agricultural activities first, and diversify into low-paid labour if resources are left over. Expected returns to unqualified labour might be less than to farming and social status motives could explain why priority is given to the farm. Note that the way the unqualified labour market is usually organised might partly explain our results: it functions on a day-to-day basis and people meet early in the morning in a given place where employers will come to recruit them. Besides transport, waiting sometimes for hours for an employment opportunity may be a waste of time and it might turn out to more efficient to stay and work on the family farm. This calls for further analysis.

Impact of vulnerability on qualified labour is, as expected, negative. Entry barriers to such activities are high (education in particular), which limits their role as risk-mitigating strategies for vulnerable households. Neither land nor the ratio of land per household member appear to influence the engagement in the qualified sector. Returns to NA qualified labour are such that no arbitrage is necessary: if a member has such an opportunity, working on the family farm will hardly be regarded as an option.

Although we have no information on whether self-employment in our data is high or low value-added, it seems to be, on average, fairly high. Education has a significant and positive impact on setting up an independent activity. Moreover both men and women engage in NA self-employment, thus suggesting that it involves the whole family. The coefficient for land is significant and negative and when we ran separate estimations using the ratio of land per household member we found the same result: households seem to undertake NA independent activities only once sufficient resources have been allocated to the farm. Relatively low land to family labour ratios could also be an incentive to diversify into NA self-employment, hence providing an income-generating activity to all members. However, unlike diversification into unskilled NA labour, which seems to take place when there are no other options, “pull factors” appear to be decisive here as the importance of the head and education variables suggest. NA self-employment is probably the main activity for most households, far from the idea that these activities solely provide complementary incomes to farming. Thus, the impact of vulnerability on the engagement in a NA independent activity is predictably negative. We also ran estimations including the amount borrowed from informal sources as a proxy for access to credit. It slightly diminished the significance and the coefficients for vulnerability and was significant (at the 10% level) and positive for engagement in NA self-employment only. This confirms our view that the NA independent

sector is not that of petty and secondary activities, as it probably requires an initial investment.

As the vulnerability indicator includes information on the income share generated by NA activities, it may be argued that the variable is significant only because being engaged in the NA sector in 1989 and in 1990 are positively correlated. Our vulnerability estimate would thus be a mere proxy for having already chosen to undertake a NA activity. We added dummies to control for participation to each of the three types of NA activities in 1989. They were found, as expected, to be strongly significant and influence positively the likelihood of engaging in the NA sector and, although significance of vulnerability diminished, it remained above the 5% level in all three cases and coefficients remained roughly identical.

Finally, we ran regressions using variables indicating to what type of vulnerability group households belonged to, i.e. low expected consumption or high volatility, although the classification is somewhat imprecise (see appendix 5). It seems that it is the fact of belonging to a group with low levels of expected food consumption that diminishes participation to the NA qualified labour market, and not being at risk of experiencing high fluctuations of consumption. This is consistent with the idea that poverty is definitely a discriminating factor in terms of access to qualified jobs. Results are slightly different for NA self-employment: low levels of expected food consumption also hinder engagement in the NA independent sector, but high volatility does too, although admittedly to a lesser extent (only significant at the 15% level). Hence, permanently poor households do not seem able to undertake NA independent activities and what is more, households facing high expected consumption volatility do not either. This calls for a further and more rigorous analysis.

VI. CONCLUSION

The NA sector is an important feature of rural areas of developing countries and Pakistan is no exception. It includes extremely different activities (wage labour versus self-employment and low-added value versus high-added value activities). Determinants of the engagement in such activities are therefore varied. One general trend however is the importance of individual characteristics, although this does not exclude that decisions may be took collectively or by the household head.

The aim of this paper was to investigate whether participation to the NA sector was, at least partly, motivated by vulnerability aspects. We constructed a simple vulnerability estimate defining vulnerability as the likelihood of experiencing food consumption poverty in the future. Based on our estimations, we found that engagement in NA unqualified wage labour, relative to undertaking no NA activity, was not significantly influenced by vulnerability, whereas it decreased participation to qualified labour and to self-employment.

These results suggest that diversification towards the NA sector may not be regarded as a risk-mitigating strategy for vulnerable households, either because they face high entry barriers or because expected returns are too low relative to agriculture.[22] An alternative explanation would be that NA activities require a considerable investment (in time at least) and imply taking new risks, in the case of self-employment in particular, which prevents households from engaging both in the NA and agricultural sectors when they are vulnerable. Moreover, as we pointed out in section two, access to land is unequal in the three Pakistani provinces surveyed: households may be reluctant to rent it out or sharecrop it in case it is difficult to retrieve later on.

[22] The vulnerable and the poor are not strictly identical groups: thus relative returns to agriculture aren't always low for vulnerable households.

The vulnerability estimate used however focuses on one single component: food consumption. It therefore excludes a wide range of factors contributing to overall vulnerability, such as malnutrition, consumption of non-food goods, education, or health for instance. It does not reflect either the types of exogenous risks encountered by households (rainfall outcomes, price fluctuations, public policies), which strongly contribute to vulnerability. Moreover, as we noted in section four, a strong implicit assumption made here is that our classification of households in terms of vulnerability corresponds to their perception of their own status. Further work, namely using subjective data, is required to refine and enrich vulnerability estimates so as to confirm or infirm results presented in this paper.

REFERENCES

Adams, R., 1997, « Non-Farm Income and Inequality in Rural Egypt and Jordan », mimeo, Washington D.C. : World Bank

Adams, R. et He, J., 1995, « Sources of Income Inequality and Poverty in Rural Pakistan », Research Report No.102, International Food Policy Research Institute, Washington D.C.

Alderman, H. and Garcia,M., 1993, « Poverty, Household Food Security, and Nutrition in Rural Pakistan », Research Report 96, International Food Policy Research Institute.

Barrett, C. and Reardon, T., 2000, « Asset, Activity, and Income Diversification Among African Agriculturalists : Some Practical Issues », mimeo, World Bank

Bigsten, A. and Kayizzi-Mugerwa, S., 1995, « Rural Sector Responses to Economic Crisis in Uganga », *The Journal of International Development*, Vol.7, No.2, pp. 181-209

Chaudhuri, S., Jalan, J., and Suryahadi, A., 2002, « Assessing household vulnerability to poverty from cross-sectional data: a methodology and estimates from Indonesia », *Discussion Paper 0102-52*, Department of Economics, Columbia University, New-York

Christiaensen, L., Boisvert, R., 2000, « Assessing household vulnerability to poverty from cross-sectional data : a methodology and estimates from India », mimeo

Corral, L. and Reardon, T., 2001, « Rural Nonfarm Income in Nicaragua », *World Development*, Vol.29, No.3, pp. 427-442

Cunningham, W. and Maloney, W.F. 2000, « Measuring Vulnerability: Who Suffered in the 1995 Mexican Crisis? », mimeo, The World Bank: Washington DC

De Janvry, A. and Sadoulet, E., 2001, « Income Strategies Among Rural Households in Mexico: The Role of Off-farm Activities », *World Development*, Vol.29, No.3, pp. 467-480

Dercon, S., 2001, « Assessing Vulnerability », Jesus College and CSAE, Department of Economics, Oxford University, mimeo

Duflo, E., and Udry, C., 2003, « Intrahousehold Resource allocation in Côte d'Ivoire: Social Norms, Separate Accounts and Consumption Choices », Centre Discussion Paper No. 857, Economic Growth Center, Yale University

Ellis, F.,1998, « Household Strategies and Rural Livelihood Diversification », *The Journal of Development Studies*, Vol.35, No.1, pp. 1-38

Escobal, J., 2001, « The Determinants of Nonfarm Income Diversification in Rural Peru », *World Development*, Vol.29, No.3, pp. 497-508

Ellis, F.,1998, « Household Strategies and Rural Livelihood Diversification », *The Journal of Development Studies*, Vol.35, No.1, pp. 1-38

Fafchamps, M. and Lund, S., 2000, « Risk-Sharing Networks in Rural Philippines », mimeo

Fafchamps, M. and Quisumbing, A., 1998, « Human Capital, Productivity and Labor Allocation in Rural Pakistan », Discussion Paper No. 48, Food Consumption and Nutrition Division, International Food Policy Research Institute, Washington D.C.

Fafchamps, M., Udry, C. and Czukas, K., 1998, « Drought and Saving in West Africa : Are Livestock a Buffer Stock ? », *Journal of Development Economics*, Vol.55, pp. 273-305

Ferreira, F. and Lanjouw, P., 2001, « Rural Nonfarm Activities and Poverty in the Brazilian Northeast », *World Development*, Vol.29, No.3, pp. 509-528

Foster, J., Greer, J. and Thorbecke, E., 1984. « Notes and Comments: A Class of Decomposable Poverty Measures », *Econometrica*, Vol.52, No.3, pp. 761-766

Haggblade,S., Hazell, P. and Brown, J., 1989, « Farm-Nonfarm Linkages in Rural Sub-Saharan Africa », *World Development*, Vol.17, No.8, pp. 1173-1201

Hazell, P. and Haggblade, S., 1990, « Rural-Urban Growth Linkages in India » in Lanjouw, J. and Lanjouw, P., 1995, « Rural Nonfarm Employment : A Survey », *Policy Research Working Paper*, No.1463, The World Bank

Hymer, S. et Resnick, S., 1969, « A Model of Agrarian Economy with Nonagricultural Activities », *American Economic Review*, Vol.59, No.4, pp. 493-506

Kamanou, G. and Morduch, J., 2001, « Measuring Vulnerability to Poverty », *mimeo*

Kochar, A., 1995, « Explaining Household Vulnerability to Idiosyncratic Shocks », *The American Economic Review*, Vol.85, Issue 2, pp. 159-164

Kochar, A., 1999, « Smoothing Consumption by Smoothing Income : Hours-of-Work Responses to Idiosyncratic Agricultural Shocks in Rural India », *The Review of Economics and Statistics*, Vol.81, No.1, pp. 50-61

Lanjouw, P., 1999, « Rural Nonagricultural Employment and Poverty in Ecuador », *Economic Development and Cultural Change*, Vol.48, No.1, pp.91-122

Ligon, E. and Schechter, L., 2003, « Measuring vulnerability », *Economic Journal forthcoming*

Lucas, R. and Stark, O., 1985, « Motivations to Remit : Evidence from Botswana », *Journal of Political Economy*, Vol.93, No.5, pp. 901-918

Morduch, J., 1995, « Income Smoothing and Consumption Smoothing », *Journal of Economic Perspectives*, Vol.9, No.3, pp. 103-114

Newman, C. and Canagarajah, S., 2000, « Gender, Poverty and Nonfarm Employment in Ghana and Uganda », mimeo, Washington D.C.: World Bank

Pritchett, L., Asep, S., and Sudarno S., 2000, « Quantifying Vulnerability to Poverty: A Proposed Measure with Application to Indonesia », mimeo

Reardon, T., 1999, « Rural Non-Farm Income in Developing Countries », *The State of Food and Agriculture 1998*. Rome : FAO

Reardon, T., Delgado, C. and Matlon, P., 1992, « Determinants and Effects of Income Diversification Amongst Farm Households in Burkina Faso », *The Journal of Development Studies*, Vol.28., No.2, pp. 264 - 296

Rosenzweig, M. and Binswanger, H., 1993, « Wealth, Weather Risk and the Composition and Profitability of Agricultural Investments », *The Economic Journal*, 103, pp. 56-78

Rosenzweig, M. and Stark, O., 1989, « Consumption Smoothing, Migration, and Marriage : Evidence form Rural India », *Journal of Political Economy*, Vol.97, No. 4, pp. 905-926

Rosenzweig, M. and Wolpin, K., 1993, « Credit Market Constraints, Consumption Smoothing, and the Accumulation of Durable Production Assets in Low-Income Countries : Investments in Bullocks in India », *Journal of Political Economy*, Vol.101, No.2, pp. 223-244

Ruben, R. and van den Berg, M., 2001, « Nonfarm Employment and Poverty Alleviation of Rural Farm Households in Honduras », *World Development*, Vol.29, No.3, pp. 549-560

Smith, R.J. & Blundell, R.W., 1986, « An Exogeneity Test for a Simultaneous Equation Tobit Model with an Application to Labor Supply », *Econometrica*, Vol. 54, No.3, pp. 679-685

Van de Walle, D., 2000, « Is the Emerging Non-Farm Market Economy the Route Out of Poverty in Viet Nam ? », Development Research Group, Washington D.C. : World Bank

APPENDIX 1: Descriptive statistics for the FGLS estimates of mean and variance

Variables	*Obs*	*Mean*	*Standard deviation*	*Min*	*Max*
Log of food consumption	686	4.278	0.830	1.936	7.664
Adult males	744	2.670	1.604	1	12
Adult females	744	2.567	1.506	1	12
Children	744	4.261	3.09	0	18
Elderly	744	0.388	0.641	0	11
Age head	744	49.62	14.45	15	87.99
Number of ill adults	612	1.08	2.023	0	4
Productive assets	742	9478.139	39827.89	0	372500
Number of cows and buffaloes	672	2.688	4.271	0	29
Number of goats and sheep	672	2.862	3.939	0	54
Amounts borrowed	748	2357.832	4524	0	40000
Share of irrigated land	461	0.622	0.468	0	1
Share of land planted with sugarcane	438	0.121	0.227	0	1
Share of crop sales in income	742	0.581	0.655	0	1
Share of NA income	742	0.469	0.428	0	1
Share of transfers	742	0.088	0.217	0	0.891

APPENDIX 2: Descriptive statistics for the probits

Variables	*Observations*	*Mean*	*Standard deviation*	*Min*	*Max*
Number of adult males	744	2.671	1.604	0	10
Number of adult females	744	2.567	1.506	0	12
Number of children	744	4.261	3.098	0	28
Number of elderly	744	0.388	0.644	0	4
Age of head	744	49.62	14.45	0	87.9
Education	738	1.161	1.316	0	7
Vulnerability	380	0.508	0.497	0	1
Land	742	6.673	9.301	0.5	93
Distance to local market	744	8.071	3.939	1.5	15
Public transport	744	0.665	0.531	0	1
Paved road	744	0.464	0.498	0	1

APPENDIX 3: An inter-temporal consumption model

In order to determine the factor influencing the ex ante mean and variance of future consumption, Christiaensen and Boisvert (2000) propose a simple two period model. Households maximize intertemporal expected utility U, with instantaneous utility u. They are risk averse ($u_c>0$ and $u_{cc}<0$) and leave no bequests. Incomes in period one and two (y_1 and y_2) are random but drawn from different probability distributions ($f_1(y_1)$ and $f_2(y_2)$) as environment characteristics, in particular those linked to risk and income generating activities may vary from one period to the next.

In period one, households are endowed with non-negative assets (A_1), yielding a stochastic real return r, and determine their consumption and assets s_1 to be transferred to the next period. Assuming imperfect credit markets:

$$\underset{c_1,c_2}{Max} u(c_1)+1/(1+\delta)Eu(c_2)$$

subject to $c_1 = y_1 + A_1 - s_1$

$$c_2 = y_2 + (1+r)s_1$$

$$s_1 \geq 0$$

where δ as the rate of time preference.

By assuming that the interest rate r is fixed, that $y_2 \sim N(\mu_{y_2}, \sigma^2_{y_2})$, that $y_1 \in \left[\underline{y_1}, \bar{y_1} \right]$ and that the instantaneous utility function u exhibits constant absolute risk aversion (CARA) and by adopting $u(c_t)=-\exp(-Rc_t)$ as a functional form for u (with R, the coefficient of absolute risk aversion), the authors find that:

$s_1^* = \phi(y_1 - y)$ if $y_1 > y^*$ (if the borrowing constraint is non-binding) (1)

$= 0$ if $y_1 \leq y^*$ (if the borrowing constraint is binding)

where $\phi = 1/(1+(1+r))$ and $y^* = (\mu_{y_2} - R\sigma^2_{y_2}/2) - A_1 - (1/R)\ln((1+r)/(1+\delta))$.

Period one consumption may be written as:

$c_1^* = y_1 + A_1 - s_1^*(y_1)$ (2)

Savings, and therefore food consumption, is to be determined with y_1 unknown at the beginning of period one and y_2 a stochastic future income. The ex ante mean and variance of food consumption are thus:

$E(c_1^*) = E(y_1) + A_1 - E(s_1^*(y_1))$ (3)

$V(c_1^*) = V(y_1) + V(s_1^*(y_1)) - 2Cov(y_1, s_1^*)$ (4)

Finally, variance may be rewritten as:

$V(c_1^*) = V(y_1)$ if $y_1 > y^*$ (5')

$V(c_1^*) = (1-\phi)^2 V(y_1)$ if $y_1 \leq y^*$

In this first model, households may not insure against risk. Using the same framework, but assuming that households derive their income from two different sources, labour (y_t) and gifts (g_t), Christiaensen and Boisvert find that:

$$E(c_1^*) = E(y_1) + A_1 + E(g_1) - \int_{h^*}^{\overline{y_1+g_1}} \varphi(y_1 + g_1 - h^*) dh(y_1 + g_1) \quad (6)$$

$V(c_1^*) = V(y_1 + g_1) + V(s_1^*(y_1 + g_1)) - 2Cov(y_1 + g_1, s_1^*)$ (7)

$V(c_1^*) = V(y_1 + g_1) + V(s_1^*(y_1 + g_1)) - 2\rho_{y_1+g_1, s_1}\sigma_{s_1}\sigma_{y_1+g_1}$ (7')

where $h^* = (\mu_{y_2+g_2} - R\sigma^2_{y_2+g_2}/2) - A_1 - (1/R)\ln((1+r)/(1+\delta))$

For an extensive discussion of the models, see Christiaensen and Boivert (2000).

Finally, the reduced forms for the ex ante mean and variance for food consumption may be expressed as:

$E(c_1^*) = k_1(E(y_1), E(g_1), A_1, \mu_{y_2+g_2}, \sigma^2_{y_2+g_2}, R, \delta, r, h(y_1 + g_1))$ (8)

$V(c_1^*) = k_2(V(y_1), V(g_1), \rho_{y_1+g_1, s_1}, A_1, \mu_{y_2+g_2}, \sigma^2_{y_2+g_2}, R, \delta, r, h(y_1 + g_1))$ (9)

The determinants of the ex ante mean and variance of food consumption may be split up into three categories: income ($E(y_1), V(y_1), h(y_1+g_1)$), savings and credit ($A_1, \mu_{y_2+g_2}, \sigma^2_{y_2+g_2}, R, \delta, r$), and insurance ($E(g_1), V(g_1), \rho_{y_1+g_1, s_1}$).

APPENDIX 4: Estimating the ex ante mean and variance of future consumption

The stochastic consumption function may be written as:

$\ln c_{it+1} = X_{it}\beta + e_{it+1}$ (1)

where X_{it} contains household characteristics and e_{it+1} is a mean-zero disturbance term. However we assume the disturbances are not identically distributed across households (heteroscedasticity) and allow the variance of e_{it+1} to depend linearly upon X_{it}:

$$\sigma^2_{eit+1} = X_{it}\theta \quad (2)$$

We estimate β and θ using a three-step feasible generalised least squares (FGLS) procedure (for details, see Chaudhuri and al. (2002)).
We start by estimating (1) using OLS to obtain an estimate of the squared residuals. We then run an OLS regression on (3):

$$\overline{e^2_{OLS,it+1}} = X_{it}\theta + u_{it+1} \quad (3)$$

Using the predictions from this regression, we estimated the weighted equation:

$$\frac{\overline{e^2_{OLS,it+1}}}{X_{it}\overline{\theta_{OLS}}} = \frac{X_{it}\theta}{X_{it}\overline{\theta_{OLS}}} + \frac{u_{it+1}}{X_{it}\overline{\theta_{OLS}}} \quad (4)$$

Having thus obtained a consistent estimate of σ^2_{eit+1}, $X_{it}\overline{\theta_{FGLS}}$, which corresponds to the household's ex ante consumption variance, we may run an OLS regression on the weighed equation:

$$\frac{\ln c_{it+1}}{\sqrt{X_{it}\overline{\theta_{FGLS}}}} = \frac{X_{it}}{\sqrt{X_{it}\overline{\theta_{FGLS}}}}\beta + \frac{e_{it+1}}{\sqrt{X_{it}\overline{\theta_{FGLS}}}} \quad (5)$$

Using the FGLS estimates for β and θ, we may finally derive the estimated ex ante mean and variance of future food consumption conditional on X_{it}:

$$\overline{\mu_{\ln cit+1}} = X_{it}\bar{\beta} \quad \text{and} \quad \overline{\sigma^2_{\ln cit+1}} = \overline{\sigma^2_{eit+1}} = X_{it}\bar{\theta}$$

APPENDIX 5: DETERMINANTS OF THE PARTICIPATION TO THE NA SECTOR USING A MULTINOMIAL LOGIT (SOURCES OF VULNERABILITY)

Variables	NA unqualified wage labour		NA qualified wage labour		NA self-employment	
	Coefficients	*P > |z|*	*Coefficients*	*P > |z|*	*Coefficients*	*P > |z|*
Number of adult males	.193	0.007	.128	0.001	.104	0.051
Number of adult females	.062	0.402	-.061	0.182	.113	0.063
Number of children	.024	0.861	-.038	0.672	.028	0.602
Number of elderly	-.035	0.897	-.885	0.369	.419	0.673
Age of head	.022	0.004	.915	0.073	.231	0.054
Age of head squared	-.001	0.058	-.003	0.098	-.004	0.327
Education	-.219	0.756	.947	0.000	.836	0.027
Low expected food consumption	-1.262	0.360	-1.495	0.094	-1.579	0.020
High volatility	-1.419	0.291	-1.025	0.938	-1.591	0.096
Land	-.031	0.027	-.029	0.258	-.021	0.023
Distance to local market	-.038	0.135	.027	0.399	.005	0.826
Paved road to tehsil capital?	-.166	0.575	-.014	0.361	.165	0.455
Public transport in the village?	. 359	0.115	.153	0.085	-.318	0.071

Source: IFPRI survey. Independent variables constructed for 1989. NA activity choices are those of 1990.
Comparison group: Engaging in no NA activity Number of observations: 358
Clustered by household, district dummies included in the regression
Instrument: number of ill members